Claims:

1. A method for transmitting data to a receiver over a data link in frames whose data-carrying capacity may vary from frame to frame, the method comprising transmitting the data in implicitly sequentially numbered blocks transmitted in at least one series of blocks, each series having at least one block, the blocks having lengths determined so that the receiver can identify the blocks by sequence number using the sequence number of the first block of each series of blocks and can individually request retransmission of a lost or corrupted block.

2. The method of claim 1, wherein the sequentially numbered blocks of a series each have a fixed length, except for the last block of a series, or the only block of a series that has only one block, which may be shorter.

3. The method of claim 2, wherein the total number of sequence numbers available for numbering the blocks is pre-selected so that the bandwidth-delay product of the data link under ideal conditions divided by the total number of sequence numbers available for numbering the blocks is not greater than the lowest data-carrying capacity that is reasonably likely to be available in a frame to transmit a series of blocks over the data link during normal operation of the data link.

4. The method of claim 3, wherein the fixed length is initially set to be greater than the bandwidth-delay product of the data link under during normal operation of the data link divided by the total number of sequence numbers available for numbering the blocks and less than the maximum data-carrying capacity that is reasonably likely to be available in a frame to transmit a series of blocks over the data link during normal operation of the data link and is reset if the bandwidth-delay product of the data link changes so that the fixed length is within a predetermined tolerance of the bandwidth-delay product of the data link divided by the total number of sequence numbers available for numbering the blocks or the maximum data-carrying capacity that is available in a frame to transmit a series of blocks over the data link.

5. The method of any of claims 2 to 4, wherein a series of blocks is encapsulated in a protocol unit together with a header that includes the sequence number of the first block of the series of blocks.

6. A method for transmitting data to a receiver over a data link in frames whose data-

carrying capacity may vary from frame to frame, the method comprising:

when data-carrying capacity is made available in a frame, transmitting the data in one or more protocol units, each discrete protocol unit having a data payload portion that is implicitly divided into sequentially numbered blocks each having a fixed length, except that the last block, or the only block if the protocol unit has only one block, is shorter if the data payload portion is not an integer multiple in length of the fixed length, and a header portion including the sequence number of the first block in the data payload portion, wherein the sequence numbers are chosen so that all blocks transmitted over the data link can be identified by sequence number by the receiver.

7. The method of claim 6, wherein the total number of sequence numbers available for numbering the blocks is pre-selected so that the bandwidth-delay product of the data link under ideal conditions divided by the total number of sequence numbers available for numbering the blocks is not greater than the lowest data-carrying capacity that is reasonably likely to be available in a frame to transmit a protocol unit having only one block over the data link during normal operation of the data link.

8. The method of claim 7, wherein the fixed length is initially set to be greater than the bandwidth-delay product of the data link under during normal operation of the data link divided by the total number of sequence numbers available for numbering the blocks and less than the maximum data-carrying capacity that is reasonably likely to be available in a frame to transmit a protocol unit having only one block over the data link during normal operation of the data link and is reset if the bandwidth-delay product of the data link changes so that the fixed length is within a predetermined tolerance of the bandwidth-delay product of the data link divided by the total number of sequence numbers available for numbering the blocks or the maximum data-carrying capacity that is available in a frame to transmit a protocol unit having only one block over the data link.

9. The method of any of claims 6 to 8, wherein if it is determined that the receiver did not receive an uncorrupted copy of a previously transmitted protocol unit and there is sufficient data-carrying capacity in the next available frame to be transmitted, then retransmitting the previously transmitted protocol unit in the next available frame before transmitting data that has not been previously transmitted

10. The method of any of claims 6 to 8, wherein if it is determined that the receiver did not receive an uncorrupted copy of a previously transmitted protocol unit and there is sufficient data-carrying capacity in the next available frame to be transmitted, then:

forming a new protocol unit from consecutive blocks of the previously transmitted protocol unit and all consecutive previously transmitted protocol units that are to be retransmitted, starting with the first block of the previously transmitted protocol unit and proceeding sequentially through the previously transmitted protocol units or units adding blocks to the newly formed protocol unit until the data-carrying capacity of the next available frame is used or a block is encountered that is not the fixed length or is larger than the remaining available data-carrying capacity,

transmitting the newly formed protocol unit in the next available frame over the data link, and

in the same manner forming and transmitting further new protocol units whenever data-carrying capacity in a frame is available until all blocks of the previously transmitted protocol unit or units have been successfully retransmitted, each newly formed protocol unit having a header including the sequence number of the first block in its data payload portion.

11. A method for transmitting an IP packet segmented into protocol units to a receiver over a data link in frames whose data-carrying capacity may vary from frame to frame, the method comprising, when data-carrying capacity of L bytes is made available in a frame, the IP packet to be transmitted is in a transmission queue, and any protocol units to be retransmitted are in a retransmission queue, repeating the following until L is zero:

(P) determining whether the retransmission queue is empty (block 402), and

if the retransmission queue is empty, then

(Q) determining whether the transmission queue is empty (block 404), and if the transmission queue is not empty,

dequeuing L bytes or the remaining bytes of the IP packet from the transmission queue, whichever is the lesser, and

decrementing L by the number of bytes dequeued (block 406),

calculating a next sequence number (block 408), and

forming a protocol unit having the next sequence number in a header and the dequeued data in a payload, the dequeued data implicitly divided into sequence number blocks consecutively numbered starting at the present sequence number, and adding the protocol unit to the frame to be transmitted, each sequence number block having a fixed length, except if the number of bytes dequeued is not an integer multiple of the fixed length, then the last block, or the only block if the number of bytes dequeued is less than the fixed length, is shorter than the fixed length (block 410),

but if the retransmission queue is not empty,

(R) determining whether the length of the sequence number block at the head of the retransmission queue is greater than L (blocks 414, 416), and

if the length of the sequence number block at the head of the retransmission queue is greater than L, proceeding to the step labeled Q above,

but, if the length of the sequence number block at the head of the retransmission queue is not greater than L, determining whether a new protocol unit is partially formed (block 418), and

if no new protocol unit is partially formed, then

dequeuing the sequence number block at the head of the retransmission queue, decrementing L by the number bytes dequeued, starting the formation of a new protocol unit having the present sequence number in a header and the

dequeued sequence number block as a payload (420), and

(S) determining whether the retransmission queue is empty (block 422), and

if the retransmission queue is empty,

(T) completing the new protocol unit and adding it to the frame to be transmitted (block 424), and

proceeding to the step labeled P above, and

if the retransmission queue is not empty,

proceeding to the step labeled R above,

but, if a new protocol unit is partially formed, then

if (i) the sequence number block at the head of the retransmission queue has a sequence number that is consecutive with the sequence number block at the tail of the partially formed protocol unit and (ii) the sequence number block at the tail block of the partially formed protocol unit is the fixed length (block 426), then

dequeuing the sequence number block at the head of the retransmission queue, appending the dequeued sequence number block to the tail of the partially formed new protocol unit, and decrementing L by the number bytes

dequeued (block 428), and

proceeding to the step labeled S above,

but otherwise, proceeding to the step labeled T above.

12. A system for transmitting data over a data link, comprising:

(a) a receiver including a microprocessor, a modem, a radio and an antenna, capable of receiving frames transmitted over the data link, the data-carrying capacity of the frames varying from time to time; and

(b) a transmitter including a microprocessor, a modem, a radio and an antenna, operable to transmit frames to the receiver over the data link, the frames including one or more protocol units, each discrete protocol unit having a data payload portion that is implicitly divided into sequentially numbered blocks each having a fixed length, except if the number of bytes carried in the payload portion is not an integer multiple of the fixed length, then the last block, or the only block if the number of bytes in the payload portion is less than the fixed length, is shorter than the fixed length, and a header portion including the sequence number of the first block in the data payload portion, wherein the sequence numbers are chosen so that all blocks transmitted over the data link can be identified by sequence number,

whereby, if it is determined that the receiver did not receive an uncorrupted copy of a previously transmitted protocol unit, then the transmitter retransmits the previously transmitted protocol unit in the next available frame to be transmitted if there is sufficient data-carrying capacity in the next available frame, but otherwise the transmitter

forms a new protocol unit from the blocks of the previously transmitted protocol unit starting with the first block of the previously transmitted protocol unit and proceeds sequentially through the previously transmitted protocol unit adding blocks to the newly formed protocol unit until the data-carrying capacity of the next available frame is used,

transmits the newly formed protocol unit over the data link, and

forms and transmits further new protocol units whenever data-carrying capacity in a frame is available until all blocks of the previously transmitted protocol unit have been successfully retransmitted, each newly formed protocol unit having a header including the sequence number of the first block in its data payload portion.

13. A protocol unit for transmitting data over a data link in frames whose data-carrying capacity may vary from frame to frame to a receiver, the protocol unit comprising a data payload portion that is implicitly divided into sequentially numbered blocks each having a fixed length, except if the number of bytes carried in the payload portion is not an integer multiple of the fixed length, then the last block, or the only block if the number of bytes in the payload portion is less than the fixed length, is shorter than the fixed length, and a header portion including the sequence number of the first block in the data payload portion, wherein the sequence numbers are chosen so that all blocks transmitted over the data link can be identified by sequence number.